

Patent
TH0996 (US)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

In re application of)
)
MAREK MATUSZ ET AL)
)
Serial No. 10/816,080) Group Art Unit: 1625
)
Filed April 1, 2004) Examiner: Raymond Covington
)
OLEFIN EPOXIDATION PROCESS) June 27, 2008
AND A CATALYST FOR USE IN)
THE PROCESS)
)

COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

APPELLANT'S BRIEF

The following brief is on appeal of a final rejection of Claims 1-30 of the above-identified U.S. patent application. The final rejection was contained in an Office Action mailed on November 27, 2007, and a Notice of Appeal was mailed on February 27, 2008. Applicants also request an extension of time for filing this appeal brief. Please charge the appropriate fees for filing this brief to Shell Oil Company Deposit Account No. 19-1800. It is respectfully requested that the Board consider the following arguments and reverse the final rejection of Claims 1-30 in the above-identified application.

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Rejection of Claims 1-30 under	
35 U.S.C. § 103(a) over U.S. 4,808,738 in view	
of WO 95/17957, U.S. 5,418,202, and EP 352850	
in further view of CA 1286687, CA488990, and	
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Real Party of Interest:

The invention of the present application is assigned to Shell Oil Company, which is the real party of interest in the present appeal.

Related Appeals and Interferences:

Appellant, and appellant's legal representative, are not aware of any appeals or interferences that directly affect or could be directly affected by or have a bearing on the Board's decision in the present appeal.

Status of the Claims:

Claims 1-30 were presented for examination. Claims 1-30 are the subject of the present Appeal and stand rejected by the Examiner.

Status of Amendments:

All amendments were entered prior to the final rejection. No amendments were filed after the mailing of the Final Office Action.

Summary of Claimed Subject Matter:

There are two independent claims on appeal, claims 1, and 19. Independent claim 1 is directed to a process for the epoxidation of an olefin. Independent claim 19 is directed to a catalyst. Claim 18 incorporates the limitations of claim 1 and claim 30 incorporates the limitations of claim 19.

The limitations of the process of Claim 1 include: 1.) reacting a feed comprising an olefin, oxygen and an organic halide (application text, as filed, at pg. 12, l. 3 – pg. 14, l. 7); 2.) in the presence of a catalyst comprising silver (application text, as filed, at pg. 8, l. 13 – pg. 9, l. 11) and rhenium deposited on a carrier, wherein the catalyst comprises rhenium in a quantity wherein the catalyst comprises rhenium in a quantity of at most 1.5 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m², relative to the surface area of the carrier (application text, as filed, at pg. 9, ll. 12-34); 3.) in which process the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst while the organic halide is present in a relative quantity Q which is maintained constant (application text, as filed, at pg. 4, ll. 22-27; pg. 17, l. 16 – pg. 18, l. 6); 4.) which relative quantity Q is the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed (application text, as filed, at pg. 5, l. 9 – pg. 6, l. 12; pg. 14, l. 26 – pg. 17, l. 5).

Claim 9 depends from claim 1 and provides the additional limitation that the rhenium content of the catalyst is in the range of from 0.1 to 1.2 mmole/kg, relative to the weight of the catalyst, and in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier (application text, as filed, at pg. 9, ll. 18-27).

Claim 17 depends from claim 16 which depends from claim 15 which depends from claim 1 and provides the additional limitation that the relative quantity Q has been maintained within at most 10 % of the value of Q at the beginning of that temperature increase (application text, as filed, pg. 17, l. 29 – pg. 18, l. 6).

The limitations of the catalyst of Claim 19 include: 1.) a catalyst comprising silver deposited on a carrier (application text, as filed, at pg. 8, l. 13 – pg. 9, l. 11); 2.) rhenium deposited on a carrier (application text, as filed, at pg. 9, ll. 12-14; 30-34); 3.) a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur,

phosphorus, boron, and compounds thereof deposited on a carrier (application text, as filed, at pg. 9-11); 4.) wherein the catalyst comprises rhenium in a quantity of at most 0.9 mmole/kg, relative to the weight of the catalyst (application text, as filed, at pg. 9, ll. 18-21); and at most 0.0015 mmole/m², relative to the surface area of the carrier (application text, as filed, at pg. 9, ll. 21-27); 5.) wherein the catalyst further comprises the rhenium copromoter in a quantity of at least 0.1 mmole/kg, based on the total of the elements, relative to the weight of the catalyst (application text, as filed, at pg. 10, ll. 2-27; pg. 11, ll. 11-15).

Grounds of Rejection to be Reviewed on Appeal:

1. Claims 1-30 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lauritzen et al US 4,808,738 (hereinafter the '738 publication) in view of Shell WO 95/17957 (hereinafter the '957 publication), Evans et al US 5,418,202 (hereinafter the '202 publication), and Lauritzen et al EP 00352850 (hereinafter the '850 publication) in further view of Habenschuss et al CA 1286687 (hereinafter the '687 publication), Carlson CA 488990 (hereinafter the '990 publication) and Evans WO 01/96324 (hereinafter the '324 publication).

Argument:

1. **Claims 1-30 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lauritzen et al US 4,808,738 in view of Shell WO 95/17957, Evans et al US 5,418,202, and Lauritzen et al EP 00352850 in further view of Habenschuss et al CA 1286687, Carlson CA 488990 and Evans WO 01/96324.**

The present invention relates to epoxidation catalysts containing a relatively small quantity of a rhenium component, as defined in the claims. It has unexpectedly been found that the catalysts of the present invention retain their selectivity better, such that after a certain period of use they outperform catalysts, which comprise a higher quantity of rhenium and/or a higher surface density of rhenium. The catalysts of the present invention accordingly have a longer service life. *See Application Text*, page 4, lines 11-27.

Claim 1

A limitation of claim 1 is that the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst, as defined in the claim, while the organic halide is present in a relative quantity Q which is maintained constant. The relative quantity Q is the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed as described in the application text, as filed, on page 5, line 9 through page 6, line 12 and page 14, line 26 through page 17, line 5.

As demonstrated in Example 2 and Tables I and II of the application text as filed, catalysts having a low rhenium content, as defined in claim 1 (e.g., Catalysts A and B), unexpectedly have an increased service life and eventually a higher selectivity when operated in an olefin epoxidation process according to claim 1 as compared to a catalyst (e.g., Catalyst F) which has a higher rhenium surface density and higher initial selectivity operated at increasing values of relative quantity Q.

In particular, in Example 2, just prior to a cumulative ethylene oxide production of 1.5 kT/m³, the selectivity for comparative Catalyst F was 80 mole-% with a reaction temperature of 285 degrees Celsius. It is noted that after a cumulative ethylene oxide production of 0.81 kT/m³, Catalyst F was no longer operated at 2.25 %v ethylene oxide content in the outlet gas stream because of severe deactivation and instead was operated at

the conditions of 1.5-2 %v ethylene oxide content in the outlet gas stream. At a cumulative ethylene oxide production of 1.6 kT/m³, the selectivity for Catalyst A, in accordance with the invention, was 81 mole-% with a reaction temperature of 270 degrees Celsius; the selectivity for Catalyst B, also in accordance with the invention, was 81 mole-% with a reaction temperature of 269 degrees Celsius; and the selectivity for Catalyst E, a comparative conventional epoxidation catalyst, was 79 mole-% with a reaction temperature of 247 degrees Celsius. This data is summarized below in Table A.

Table A

Catalyst	Ag (g/kg)	Re * mmole/kg	Re (mmole/m ²)	W*	Cs*	Li*	Initial Sel. mole-%	Initial Temp. °C	Q ₁	Sel. at 1.6 kT/m ³ mole-%	Temp. at 1.6 kT/m ³ °C	Q ₂
A ¹⁾	132	0.75	0.0010	0.35	2.6	20	83	234	10 x 10 ⁻⁶	81	269	10 x 10 ⁻⁶
B ¹⁾	132	0.75	0.0010	0.35	3.1	10	84 ³⁾	251 ³⁾	10 x 10 ⁻⁶	81	270	10 x 10 ⁻⁶
E ²⁾	147	0	0	0	2.9	0	82	233	10 x 10 ⁻⁶	79	247	10 x 10 ⁻⁶
F ²⁾	132	1.5	0.0019	0.7	3.2	15	90	253	10.4 x 10 ⁻⁶	(80) ⁴⁾	(285) ⁴⁾	(19.2 x 10 ⁻⁶) ⁴⁾

* mmole/kg

1) invention

2) comparative

3) at 0.24 kT/m³

4) data collected just prior to discontinuing the run at 1.5 kT/m³; after 0.81 kT/m³ the ethylene oxide content in the outlet gas was adjusted from 2.25 %v to between 1.5 to 2 %v due to severe deactivation

Example 2 shows that, at the lower content of rhenium, the catalysts of the present invention unexpectedly have an increased service life and eventually produce the olefin oxide at a higher selectivity (operated at a constant value of relative quantity Q) than the catalyst which has a higher rhenium surface density and higher initial selectivity (operated at increasing values of relative quantity Q). The catalysts having lower rhenium content, as claimed in the present invention, also unexpectedly outperform the conventional epoxidation catalyst (rhenium-free catalyst), producing more olefin oxide over their lifetime. *See Application text, as filed, pg. 28, ll. 1-8; Example 2.* This improvement in catalyst performance is especially unexpected in light of the '850 publication, discussed further hereinafter, which teaches that for a highly selective catalyst an improvement in stability is obtained by increasing the chlorohydrocarbon moderator level over the period of operation of the catalyst. *See European Patent No. 352850, page 2, lines 38-39.*

To establish a *prima facie* case of obviousness, there must be a suggestion of all the elements in a claim. *See CFMT, Inc. v. Yieldup Int'l Corp.*, 349 F.3d 1333, 1342 (Fed. Cir. 2003). There must also be “a reason that would have prompted a person of ordinary skill in the art to combine the elements as the new invention does.” *See KSR Int'l v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007).

The ‘738 publication relates to a catalyst for the production of ethylene oxide which catalyst comprises silver, alkali metal, rhenium and a rhenium co-promoter selected from sulfur, molybdenum, tungsten, chromium and mixtures thereof. *See U.S. Patent No. 4,808,738*, col. 2, ll. 3-11. The ‘738 publication discloses the use of a chlorohydrocarbon moderator in the reaction feed as well as hydrocarbons. *See Id.* at col. 17, ll. 21-60; Table 2. The ‘738 publication is completely silent regarding operating conditions as the highly selective catalyst ages and deactivates.

The ‘850 publication, in describing the state of the art, discloses maintaining constant the chlorohydrocarbon moderator levels in the reactor feed over the period of operation of a non-rhenium containing “conventional” catalyst. *See European Patent Specification 352850 B1*, page 2, lines 6-27. The ‘850 publication teaches that catalysts containing silver and rhenium have longer catalyst lives when the chlorohydrocarbon moderator level is increased over the period of operation of the catalyst. *See Id.* at page 2, lines 30-48. The working examples of the ‘850 publication provide data showing that an improvement in catalyst life can be obtained when the quantity of chlorohydrocarbon moderator is increased (keeping the quantity of hydrocarbons constant) over the period of operation of the rhenium-containing catalyst. Increasing the concentration of the chlorohydrocarbon in the reaction feed leads to an increased value for the relative quantity Q when the other components in the feed are kept constant as done in the examples of the ‘850 publication. Thus, the ‘850 publication teaches away from maintaining constant the relative quantity Q of the organic halide when operating a rhenium-containing catalyst.

Therefore, there is no reason provided in the ‘850 publication that would have prompted a person of ordinary skill in the art to combine the elements as in claim 1, in particular increasing the reaction temperature during the epoxidation process to at least partly reduce the effect of loss of activity of the rhenium-containing catalyst, as defined

in claim 1, while the organic halide is present in a relative quantity Q which is maintained constant. Further, as discussed above, it is unexpected that the process of the present invention results in the catalysts, as defined in claim 1, having an increased service life and eventually producing the olefin oxide at a higher selectivity than the catalysts which have a higher rhenium surface density and higher initial selectivity. It is also unexpected that the process of the present invention results in catalysts, as defined in claim 1, also outperforming conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime.

The '324 publication also teaches that, for conventional catalysts which do not contain rhenium, the concentration of moderator can remain the same during the entire lifespan of the catalyst; however, for a highly selective catalyst, the optimum amount of moderator in the reaction feed tends to change during prolonged operation. *See PCT International Application Publication No. WO 01/96324, page 8, lines 5-21.* The '324 publication also discloses increasing the ethylene concentration in the reaction feed during a further operation phase of the epoxidation process such that the ethylene concentration is increased by 5 to 30 mole-%, preferably 10 to 20 mole-%. *See Id.* at page 6, ll. 11-18.

However, the '324 publication does not provide a reason that would have prompted a person of ordinary skill in the art to combine the elements as in claim 1, in particular increasing the reaction temperature during the epoxidation process to at least partly reduce the effect of loss of activity of the rhenium-containing catalyst, as defined in claim 1, while the organic halide is present in a relative quantity Q which is maintained constant. Further, as discussed above, it is unexpected that the process of the present invention results in the catalysts, as defined in claim 1, having an increased service life and eventually producing the olefin oxide at a higher selectivity than the catalysts which have a higher rhenium surface density and higher initial selectivity. It is also unexpected that the process of the present invention results in catalysts, as defined in claim 1, also outperforming conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime.

The '957 and '202 publications are from the same patent family and have similar disclosures; thus, they will be discussed together. The '957 and '202 publications

disclose the presence of hydrocarbons and chlorohydrocarbon moderators in the reaction feed. *See PCT International Application Publication No. WO95/17957*, page 11, line 25 – page 12, line 2; Table I; page 19, lines 28-31; page 26, line 18 – page 20, line 2; *U.S. Patent No. 5,418,202*, column 11, lines 41-54; Table I; column 18, lines 43-47; column 22, lines 22-26. The ‘957 and ‘202 publications, in describing the state of the art, disclose gradually increasing the reactor temperature as the catalyst activity declines. *See PCT International Application Publication No. WO95/17957*, page 1, lines 23-25; *U.S. Patent No. 5,418,202*, column 1, lines 35-41. The ‘957 and ‘202 publications disclose an increase in temperature during the start-up of the reactor in the working examples. Such a temperature increase would not be contemplated by a person of ordinary skill in the art as a temperature increase to partly reduce the effect of loss of activity of the catalyst. Illustrative embodiment 2 discloses an increased temperature value after 215 days of operation of the reactor. In the working examples of the ‘957 and ‘202 publications, the reactor feed contained 0.5 to 5 ppmv ethyl chloride during the testing of the catalysts. *See PCT International Application Publication No. WO95/17957*, page 19, lines 28-31; *U.S. Patent No. 5,418,202*, column 18, lines 43-47.

The ‘687 publication, in describing the state of the art, also discloses increasing the reaction temperature to compensate for the deactivation of a catalyst. *See Canadian Patent No. 1286687*, page 6, line 29 - page 7, line 23; page 8, ll. 17-25. The ‘687 publication discloses the presence of hydrocarbons and halide in the reaction feed. *See Id.* at page 36, lines 16-28; page 39, lines 3-14; Tables A and B. The ‘687 publication is silent regarding operating conditions as the catalyst ages and deactivates.

The ‘990 publication describes using a small amount (i.e., in the range of from 0.1 to 3 ppmv) of ethylene dichloride moderator in the reaction feed in contact with a conventional silver catalyst to allow use of higher operating temperatures while improving the ethylene oxide conversion and yield. *Canadian Patent No. 488990*, page 3, lines 3-20.

The ‘957, ‘202, ‘687, and ‘990 publications also do not provide a reason, especially in light of the teaching of the ‘850 publication, that would have prompted a person of ordinary skill in the art to combine the elements as in claim 1, in particular increasing the reaction temperature during the epoxidation process to at least partly

reduce the effect of loss of activity of the rhenium-containing catalyst, as defined in claim 1, while the organic halide is present in a relative quantity Q which is maintained constant. Further, as discussed above, it is unexpected that the process of the present invention results in the catalysts, as defined in claim 1, having an increased service life and eventually producing the olefin oxide at a higher selectivity than the catalysts which have a higher rhenium surface density and higher initial selectivity. It is also unexpected that the process of the present invention results in catalysts, as defined in claim 1, outperforming conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime.

In view of these arguments, Applicants respectfully submit that Claim 1 is unobvious and patentable over the art cited by the Examiner. As claims 2-16 and 18 depend from or incorporate the limitations of claim 1, they are also unobvious and patentable over the art cited by the Examiner.

Claim 9

The process for the epoxidation of an olefin of claim 9 includes the limitation of “the rhenium content of the catalyst is in the range of from 0.1 to 1.2 mmole/kg, relative to the weight of the catalyst, and in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier.” The art cited by the Examiner does not provide a reason, especially in light of the teaching of the ‘850 publication, that would have prompted a person of ordinary skill in the art to increase the reaction temperature during the epoxidation process to at least partly reduce the effect of loss of activity of a catalyst having a rhenium content in the range of from 0.1 to 1.2 mmole/kg, relative to the weight of the catalyst, and in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier, while the organic halide is present in a relative quantity Q which is maintained constant. Further, as discussed above, it is unexpected that the process of the present invention results in the catalyst, as defined in claim 9, having an increased service life and eventually producing the olefin oxide at a higher selectivity than catalysts which have higher rhenium content/higher rhenium surface density and higher initial selectivity. It is also unexpected that the process of the present invention results in catalysts, as defined in claim 9, outperforming

conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime.

In view of these arguments, Applicants respectfully submit that Claim 9 is unobvious and patentable over the art cited by the Examiner. As claim 10 depends from claim 9, it is also unobvious and patentable over the art cited by the Examiner.

Claim 17

The process for the epoxidation of an olefin of claim 17 includes the limitation of “the relative quantity Q has been maintained within at most 10 % of the value of Q at the beginning of that temperature increase.” This feature is not taught or suggested by the art cited by the Examiner. Claim 17 incorporates the limitations of claim 1 and further limits claims 15 and 16. The art cited by the Examiner does not provide a reason, especially in light of the teaching of the ‘850 publication, that would have prompted a person of ordinary skill in the art to maintain the relative quantity Q within at most 10 % of the value of Q at the beginning of a temperature increase of 10 °C to at least partly reduce the effect of loss of activity. Further, as discussed above, it is unexpected that the process of the present invention unexpectedly results in the catalysts, as defined in the claim, having an increased service life and eventually producing the olefin oxide at a higher selectivity than catalysts which have a higher rhenium surface density and higher initial selectivity. It is also unexpected that the process of the present invention results in catalysts, as defined in the claim, outperforming conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime.

In view of these arguments, Applicants respectfully submit that Claim 17 is unobvious and patentable over the art cited by the Examiner.

Claim 19

The catalyst of claim 19 comprises silver, rhenium and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorous, boron and compounds thereof deposited on a carrier. Rhenium is present in a quantity of at most 0.9 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m², relative to the surface area of the carrier (rhenium surface density). The rhenium copromoter is present in a quantity of at least 0.1 mmole/kg, based on the total elements, relative to the weight of the catalyst.

Example 2, see above, shows that, at the lower content of rhenium, the catalysts of the present invention unexpectedly have an increased service life and eventually produce the olefin oxide at a higher selectivity than the catalysts which have higher rhenium content/higher rhenium surface density and higher initial selectivity. The catalysts having the lower rhenium content, as claimed in the present invention, also unexpectedly outperform conventional epoxidation catalysts (rhenium-free catalysts), producing more olefin oxide over their lifetime. *See Application text, as filed, pg. 28, ll. 1-8.*

In view of these arguments, Applicants respectfully submit that Claim 19 is unobvious and patentable over the art cited by the Examiner. As claims 20-30 depend from or incorporate the limitations of claim 19, they are also unobvious and patentable over the art cited by the Examiner.

In conclusion, for the reasons set forth above, the Applicants request that the Board overturn the Examiner's rejection of Claims 1-30.

Respectfully submitted,
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Claims Appendix:

1. (Original) A process for the epoxidation of an olefin, which process comprises reacting a feed comprising an olefin, oxygen and an organic halide, in the presence of a catalyst comprising silver and rhenium deposited on a carrier, wherein the catalyst comprises rhenium in a quantity of at most 1.5 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m², relative to the surface area of the carrier, and in which process the reaction temperature is increased to at least partly reduce the effect of loss of activity of the catalyst while the organic halide is present in a relative quantity Q which is maintained constant, which relative quantity Q is the ratio of an effective molar quantity of active halogen species present in the feed to an effective molar quantity of hydrocarbons present in the feed.
2. (Original) A process as claimed in claim 1, wherein the carrier is an α -alumina carrier having a surface area in the range of from 0.3 to 5 m²/g, relative to the weight of the carrier.
3. (Original) A process as claimed in claim 2, wherein the surface area of the carrier is in the range of from 0.5 to 3 m²/g, relative to the weight of the carrier.
4. (Original) A process as claimed in claim 1, wherein the silver content of the catalyst is in the range of from 50 to 400 g/kg, relative to the weight of the catalyst.
5. (Original) A process as claimed in claim 1, wherein the rhenium content of the catalyst is in the range of from 0.1 to 1.2 mmole/kg, relative to the weight of the catalyst.
6. (Original) A process as claimed in claim 5, wherein the rhenium content of the catalyst is in the range of from 0.2 to 0.9 mmole/kg, relative to the weight of the catalyst.
7. (Original) A process as claimed in claim 1, wherein the rhenium content of the catalyst is in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier.
8. (Original) A process as claimed in claim 7, wherein the rhenium content of the catalyst is in the range of from 0.0001 to 0.0012 mmole/m², relative to the surface area of the carrier.
9. (Original) A process as claimed in claim 1, wherein the rhenium content of the catalyst is in the range of from 0.1 to 1.2 mmole/kg, relative to the weight of the catalyst,

and in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier.

10. (Original) A process as claimed in claim 9, wherein the rhenium content of the catalyst is in the range of from 0.2 to 0.9 mmole/kg, relative to the weight of the catalyst, and in the range of from 0.0001 to 0.0012 mmole/m², relative to the surface area of the carrier.

11. (Original) A process as claimed in claim 1, wherein the catalyst comprises in addition a Group IA metal or compound thereof in a quantity of from 0.01 to 500 mmole/kg, calculated as the element on the total catalyst, and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorus, boron, and compounds thereof, in a quantity of from 0.1 to 30 mmole/kg, based on the total of the elements, relative to the weight of the catalyst.

12. (Original) A process as claimed in claim 1, wherein the olefin is ethylene and the organic halide is a chlorohydrocarbon.

13. (Original) A process as claimed in claim 1, wherein the relative quantity Q is in the range of from 2×10^{-6} to 60×10^{-6} .

14. (Original) A process as claimed in claim 13, wherein the relative quantity Q is in the range of from 3×10^{-6} to 50×10^{-6} .

15. (Original) A process as claimed in claim 1, wherein for any temperature increase of 10 °C to at least partly reduce the effect of loss of activity of the catalyst the relative quantity Q has been maintained within at most 20 % of the value of Q at the beginning of that temperature increase.

16. (Original) A process as claimed in claim 15, wherein the relative quantity Q has been maintained within at most 15 % of the value of Q at the beginning of that temperature increase.

17. (Original) A process as claimed in claim 16, wherein the relative quantity Q has been maintained within at most 10 % of the value of Q at the beginning of that temperature increase.

18. (Original) A process for the production of a 1,2-diol, a 1,2-diol ether or an alkanolamine comprising converting an olefin oxide into the 1,2-diol, the 1,2-diol ether

or the alkanolamine wherein the olefin oxide has been obtained by a process for the epoxidation of an olefin as claimed in claim 1.

19. (Previously Presented) A catalyst comprising silver, rhenium and a rhenium copromoter selected from tungsten, molybdenum, chromium, sulfur, phosphorus, boron, and compounds thereof deposited on a carrier, wherein the catalyst comprises rhenium in a quantity of at most 0.9 mmole/kg, relative to the weight of the catalyst, and at most 0.0015 mmole/m², relative to the surface area of the carrier, and wherein the catalyst further comprises the rhenium copromoter in a quantity of at least 0.1 mmole/kg, based on the total of the elements, relative to the weight of the catalyst.

20. (Previously Presented) A catalyst as claimed in claim 19, wherein the carrier is an α -alumina carrier having a surface area in the range of from 0.3 to 5 m²/g, relative to the weight of the carrier.

21. (Previously Presented) A catalyst as claimed in claim 20, wherein the surface area of the carrier is in the range of from 0.5 to 3 m²/g, relative to the weight of the carrier.

22. (Previously Presented) A catalyst as claimed in claim 19, wherein the silver content of the catalyst is in the range of from 50 to 400 g/kg, relative to the weight of the catalyst.

23. (Previously Presented) A catalyst as claimed in claim 19, wherein the rhenium content of the catalyst is in the range of from 0.1 to 0.9 mmole/kg, relative to the weight of the catalyst.

24. (Previously Presented) A catalyst as claimed in claim 23, wherein the rhenium content of the catalyst is in the range of from 0.2 to 0.9 mmole/kg, relative to the weight of the catalyst.

25. (Previously Presented) A catalyst as claimed in claim 19, wherein the rhenium content of the catalyst is in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier.

26. (Previously Presented) A catalyst as claimed in claim 25, wherein the rhenium content of the catalyst is in the range of from 0.0001 to 0.0012 mmole/m², relative to the surface area of the carrier.

27. (Previously Presented) A catalyst as claimed in claim 19, wherein the rhenium content of the catalyst is in the range of from 0.1 to 0.9 mmole/kg, relative to the weight

of the catalyst, and in the range of from 0.00005 to 0.0013 mmole/m², relative to the surface area of the carrier.

28. (Previously Presented) A catalyst as claimed in claim 27, wherein the rhenium content of the catalyst is in the range of from 0.2 to 0.9 mmole/kg, relative to the weight of the catalyst, and in the range of from 0.0001 to 0.0012 mmole/m², relative to the surface area of the carrier.

29. (Previously Presented) A catalyst as claimed in claim 19, wherein the catalyst comprises in addition a Group IA metal or compound thereof in a quantity of from 0.01 to 500 mmole/kg, calculated as the element on the total catalyst, and the rhenium copromoter in a quantity of from 0.1 to 30 mmole/kg, based on the total of the elements, relative to the weight of the catalyst.

30. (Previously Presented) A process for the preparation of a catalyst as claimed in claim 19, which process comprises depositing silver and sufficient quantities of rhenium and the rhenium copromoter on a carrier.

Evidence Appendix: None

Related Proceedings Appendix: None